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FROST PROTECTION OF FERNS BY SPRINKLER IRRIGATION

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Considerable attention has been given by growers to the matter of frost protection by irrigation. Many attempts have been made to protect orchard trees by sprinkling with water with disastrous results since the weight of the ice formed on cold nights usually is greater than the trees can bear and the resultant damage by breakage generally is greater than the damage caused by the frost on unsprinkled trees. Experiments conducted by the Florida Horticultural Protection Service have shown that it is possible to protect certain ground crops from frost damage against severely low temperatures by sprinkler irrigation. Observations as to the effectiveness of this method of frost protection are presented in this discussion.

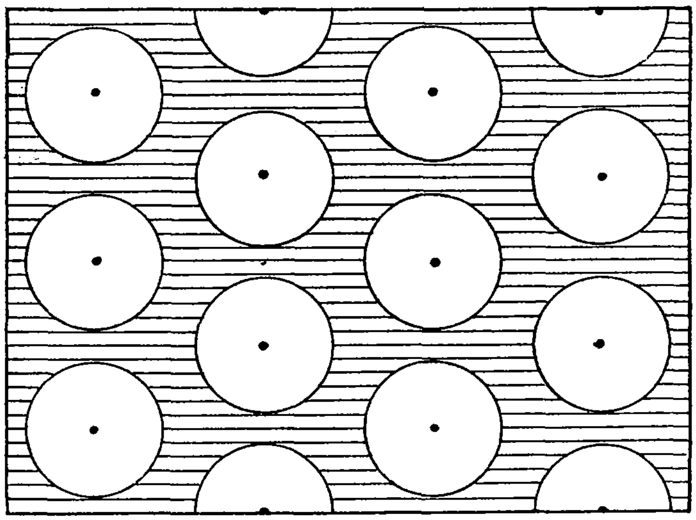

FIGURE 1.—Section of fernery showing how sprinklers were placed. Unshaded circles show area adequately protected by each sprinkler. Shaded portions show area where ferns were damaged. Sprinkler heads were 30 feet apart and radius of coverage was 12 feet.

Protection of ferns from frost damage by spraying water continuously upon the plants during periods of damaging temperatures was attempted on a plot of ferns during the cold weather of the 1937–38 winter season in Florida. The ferns were of the asparagus plumosus variety, used extensively by florists. The test plot was located in the Peerless fernery of the Winter Park Ferneries, Inc., at Fern Park, Fla. Ten of the fourteen acres in the Peerless fernery were equipped with oil heaters for protection against damaging temperatures. The four-acre test plot was not equipped with heaters and was separated from the rest of the fernery by a high board fence which isolated it from the heated area. The test plot was located in the northern part of the fernery, which made the effect from the heaters in the other plot too small to be of consequence since the nocturnal air drift was mostly from the north. Revolving sprinklers were arranged 30 feet apart in 30-foot rows in staggered formation. Water for irrigation was pumped from a nearby lake through underground mains. At the time of installation the sprinklers had not been placed close enough together to completely cover the intervening spaces with water spray, and a space of from 4 to 8 feet in the center between each two sprinklers was not consistently covered. The relative positions and coverage of the sprinklers are diagrammed.

On the morning of December 7, when the temperature inside the fernery had fallen to 33° F. at 1 a. m., the sprinklers were set in operation. Ice began covering the ferns very soon as the temperature continued to fall rapidly. The temperature at the station outside the fernery fell to 23.4° F. with a duration of 9½ hours at 32° and below. Before sunrise the entire plot was covered with ice which did not entirely melt throughout the following day, and the irrigation was kept going continuously. On the next morning, the temperature at the outside station fell to 24.0° F., with 13¼ hours at 32° and below. December 8 was a much warmer day and by late afternoon all the ice in the fernery had melted and the irrigation pumps were shut down after being in continuous operation for more than 40 hours. About an hour after the irrigation was started a thin coating of ice had formed over the fronds on each runner and ice continued to form all night. It was found that the ice had formed long icicles as the water sprinkled on top of the ferns dripped downward. The ferns were in nearly normal position due to the structural support given by the ice girders and had not been pressed to the ground by the weight of the ice, as might have been expected. A small amount of displacement does little damage to this variety of fern, which has tough pliable stems.

A few days later the fernery was examined for frost damage. Around each sprinkler for a radius of about 12 feet the ferns were in good condition and it was difficult to find a spray which showed any sign of frost damage. Damage in this area was less than 5 percent. The space between sprinklers where the coverage was not good or entirely lacking received 75 to 100 percent damage. The area of damaged ferns appeared as a ring outside a radius of about 12 feet from each sprinkler head. This radius was slightly variable due to the covering efficiency of the individual sprinklers.

The ferns in an unprotected nearby fernery were a total loss. The minimum temperature at this fernery on December 7 was 26.1° F., with 9 hours at 32° and below; and on December 8 was 27.6° F., with 12¾ hours at 32° and below. These temperatures were not as low as at the Peerless fernery.

An interesting sidelight on the experiment appeared in another nearby fernery. The same irrigation mains served both ferneries and when the pumps were started at 1 a. m. on December 7 at the Peerless fernery, the mains and sprinklers in a portion of the other fernery had not been closed. All of this fernery was equipped with oil heaters for frost protection and when the lighting of the heaters was begun, it was discovered that some sprinklers were operating. At that time, ice was just beginning to appear on the wet ferns. The sprinklers were turned off immediately and the heaters were lighted and burned throughout the period of damaging temperature. A few days after the cold spell, in the section where the irrigation had operated before heaters were lighted the ferns were a total loss for a space of about 12 feet around each sprinkler. In the spaces between sprinklers where the ferns had not been wet the damage was about 20 percent. The remainder of the fernery, which received no irrigation, also had damage of about 20 percent which was due to delay in getting the heaters lighted. According to this it appears that once spraying is begun it must be continued without interruption during the period of damaging cold.

In the cold spell of January 27, 28, and 29 the same method of protection was again used in the 4-acre plot of the Peerless fernery. At this time there was a good crop of ferns throughout most of the plot. On the morning of January 27, the temperature in the outside station reached 26.3° F. with 3¼ hours at 32° and lower. On the morning of January 28, the temperature reached 26.5° F., with 4 hours at 32° and lower, and on the morning of January 29, it reached 26.3° F., with 11¼ hours at 32° and lower. On each morning the sprinklers were started just before the temperature inside the fernery reached 32° and were continued into the next day without interruption, until all the ice had melted.

The fernery was again examined for frost damage a few days after the cold spell had ended. Damage again was confined to the unsprinkled area about halfway between sprinklers; the loss here was 75 to 100 percent. Around each sprinkler for a radius of about 12 feet it was difficult to find a frond which showed any sign of damage.

The operating expense was very small. The equipment had been installed for the purpose of irrigating during dry weather, and the cost for upkeep and depreciation could be divided for this reason. The principal item of expense was for electric power to operate the pumps, which was figured to be less than $1 per hour for the 4-acre plot. With additional sprinklers per acre the cost would have been very slightly higher.

The manager of the Peerless fernery, Hibbard Casselberry, states that he has practiced sprinkler frost protection with success in different ferneries at different times. He states that his only difficulty with this type of frost protection has been due to power failure, since a break-down while the ferns are covered with ice usually results in a complete loss of the crop. In his opinion, the type of soil is also important, and the method is better adapted to sandy soil of thirsty nature. In heavy soils, the large amount of irrigation water which is sometimes required might do considerable damage to the plants.

Attempt is not made to draw any sweeping conclusions from the results of this experiment since a much greater amount of data should be accumulated before generalizations are made. The facts brought out may be taken to indicate the reasonable possibility that frost damage to low-growing, tough, woody plants may be prevented at moderate cost by means of sprinkler irrigation properly managed, especially in the case of ferns which apparently suffer no harm from being coated with ice, provided the temperature of the ice is maintained at 32° by continuous spraying.

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[RICHMOND T. ZOCH, *in Charge of Library*]

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